

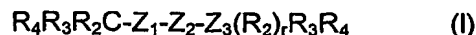
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Claims

1. A flame retardant composition, which comprises

(a) a polymeric substrate, and

(b) at least one compound of formula (I)



wherein Z_1 and Z_2 are both NR_1 and Z_3 is C or N; r is 0, when Z_3 is N, and r is 1, when Z_3 is C;

the two R_1 's form together a bond or each R_1 is independently H or forms a bond together with R_2 present at the adjacent C-atom or, respectively, Z_3 ;

each R_2 independently forms a bond or is a monovalent radical as defined for R_3 and R_4 below;

each R_3 is independently and each R_4 is independently a monovalent radical selected from H, optionally substituted alkyl, optionally substituted alkyl interrupted with one or more O, N and/or S atom(s), optionally substituted cycloalkyl, optionally substituted cycloalkylalkyl, optionally substituted aryl, optionally substituted arylalkyl, optionally substituted alkoxy(alkyl)_n, optionally substituted aryloxy(alkyl)_n, optionally substituted arylalkyloxy(alkyl)_n, optionally substituted alkenyl, optionally substituted alkenyloxy(alkyl)_n, optionally substituted alkynyl, optionally substituted alkynyloxy(alkyl)_n, optionally substituted heterocyclyl(O)_s(alkyl)_n with one to four heteroatoms selected independently from N, O and S; $R-Y-C(O)-(alkyl)_n$ or $R-C(O)-Y-(alkyl)_n$, wherein each R independently is H, alkyl, alkenyl, cycloalkyl, aryl or heterocyclyl as defined above, each of which is optionally substituted, Y is O or NH;

or at one or both of the C-atom and Z_3 , as given in the above formula (I), R_3 and R_4 form together with said C-atom or, respectively Z_3 , wherein they are attached to, an optionally substituted, saturated, partially saturated or aromatic, mono- or polycyclic ring system of 5 to 20 carbon and, optionally, hetero ring atoms, whereby the optional hetero ring atoms are selected from N, O and/or S; and R_2 is a monovalent radical as defined for R_3 and R_4 above, or forms a bond between the C-atom and Z_1 or, respectively, between Z_3 and Z_2 , or forms a

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bond in the ring system formed by R_3 and R_4 between said C-atom or, respectively, Z_3 , and a ring atom adjacent thereto;

each s and n is independently 0 or 1;

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or Z_3 forms together with R_2 , if present, R_3 and R_4 , which are attached thereto, a group – $R'_5([Z_1-Z_2-R_6]_k Z_1-Z_2-R_5-H)_t$, wherein each R'_5 and R_5 is independently optionally substituted alkylene, optionally substituted alkylene interrupted with one or more N, O and/or S, optionally substituted cycloalkylene, optionally substituted cycloalkylenealkylene, optionally substituted cycloalkylenealkylenecycloalkylene, optionally substituted arylene, optionally substituted arylenealkylene, optionally substituted arylenealkylenearylene, optionally substituted heterocyclylene, optionally substituted heterocyclylenealkylene or optionally substituted heterocyclylenealkyleneheterocyclylene, each R_6 independently has a meaning as given for R'_5 and R_5 above, Z_1 and Z_2 are each independently as defined above, t is 1-3 and k is chosen so that the molecular weight of the resulting compound of formula (I) is within 200 to 10000 g/mol;

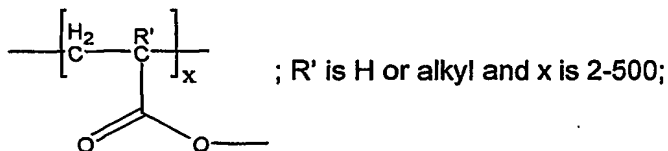
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or Z_3 together with R_2 , if present, R_3 and R_4 , which are attached thereto, represent a linking group – R_8 – to form $R_2R_3R_4C-Z_1-Z_2-R_8-[U]_x$ which denotes a recurring structural unit of a polymer, wherein R_8 is a linking bond or alkylene, cycloalkylene, heterocyclylene or arylene;

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U is a $\left[\text{CH}_2 - \underset{\text{O}}{\underset{\text{O}}{\text{C}}} \text{R}' \right]_x$, or



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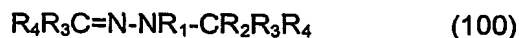
or the two R_3 's, as given in the above formula (I), form together with the $-(R_2R_4)C-Z_1-Z_2-Z_3((R_2)_rR_4)-$ moiety an optionally substituted, saturated, partially saturated or aromatic, mono- or polycyclic ring system of 5 to 20 carbon and, optionally, further hetero ring atoms, whereby the further hetero ring atoms are selected from one or two of N, O and/or S; and wherein Z_1 to Z_3 , r and R_2 to R_4 are as defined above;

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as well as an oxide of N as Z_1 - Z_3 , a salt, an ester or an amide thereof, or of a mixture of two or more compounds of formula (I) as defined above;

with the proviso that in the compound of formula (I) at least at one of the C-atom and Z_3 , as depicted in the above formula (I), R_3 and R_4 are independently other than H and R_2 is H or a bond;

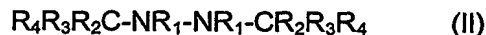
with the further proviso that when the compound of formula (I) is a compound of formula (100),



the polymeric substrate (a) is not an aromatic alkenyl homo or copolymer.

2. A flame retardant composition according to claim 1, wherein the compound of formula (I) is selected from the following compounds of formulae (II)-(III):

a compound of formula (II)



wherein the two R_1 's form together a bond, or each R_1 independently is H or forms a bond together with R_2 present at the adjacent C-atom as defined in claim 1;

a compound of formula (III)



wherein the two R_1 's form together a bond;

wherein in the above formulae (II)-(III) R_1 to R_4 are defined in claim 1.

3. A flame retardant composition according to claim 1, wherein in the compound of formula (I) both at the C-atom and at the Z_3 -atom R_3 and R_4 are other than H and R_2 is H or a bond.

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4. A flame retardant composition according to claim 1, wherein the compound (I) is acyclic and -Z₁-Z₂- is symmetrically substituted.
5. A flame retardant composition according to claim 1, wherein the compound (I) is acyclic and -Z₁-Z₂- is unsymmetrically substituted.
6. A flame retardant composition according to claim 1, wherein the compound of formula (I) is a compound of formula R₄R₃R₂C-N=N-CR₂R₃R₄ (IIa).
7. A flame retardant composition according to claim 2, wherein the compound of formula (II) is acyclic and R₃ and R₄ at the same C-atom form together therewith an optionally substituted, saturated, partly saturated or aromatic, mono- or polycyclic ring system as defined in claim 1, wherein said rings are selected from cycloalkyl or aryl which is unsubstituted or substituted with 1-3 of -OH, -NH₂, -COOH, alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkylalkyl, aryl, arylalkyl, alkyl-C(O)-O-, alkenyl-C(O)-O-, and/or alkyl-O-C(O)-, whereby cycloalkyl and/or aryl moiety as or in said substituents is optionally substituted with alkenyl.
8. A flame retardant composition according to claim 1, wherein Z₃ forms together with R₂, R₃ and R₄, which are attached thereto, a group -R'₅([Z₁-Z₂-R₆]_kZ₁-Z₂-R₅-H)_l as defined in claim 1, wherein each R'₅ and R₅ is independently optionally substituted alkylene, optionally substituted cycloalkylene, optionally substituted cycloalkylenealkylene, optionally substituted arylene, optionally substituted arylenealkylene, optionally substituted heterocyclylene, optionally substituted heterocyclylenealkylene, optionally substituted cycloalkylenealkylenecycloalkylene, optionally substituted arylenealkylenearylene or optionally substituted heterocyclylenealkyleneheterocyclylene; each R₆ independently is optionally substituted alkylene, optionally substituted alkylene interrupted with one or more N, O and/or S, optionally substituted cycloalkylene, optionally substituted cycloalkylenealkylene, optionally substituted cycloalkylenealkylenecycloalkylene, optionally substituted arylene, optionally substituted arylenealkylene, optionally substituted arylenealkylenearylene, optionally substituted heterocyclylene, optionally substituted heterocyclylenealkylene or

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optionally substituted heterocyclylenealkyleneheterocyclylene, each $-Z_1-Z_2-$ are $-NR_1-NR_1-$, t is 1 or 2, and k is as defined in claim 1.

- 5 9. A flame retardant composition according to claim 2, wherein the compound of formula (II) is selected from bis(cycloalkylazocycloalkyl)alkane, cycloalkylalkylazoalkane, arylalkylazoarylalkane, cycloalkylazoalkane, cycloalkylazocycloalkane, arylazoalkane and arylazoaryl compounds, preferably from bis(cycloalkylazocycloalkyl)alkane, cycloalkylazoalkane or cycloalkylazocycloalkane, whereby any of the alkyl-, aryl-, arylalkyl-,
10 cycloalkyl- and cycloalkylalkyl is optionally substituted with 1-3 substituents.

10. A flame retardant composition according to claim 1, wherein the compound of formula (I) is a compound of formula (IIb)

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- wherein one or both of (R_3 and R_4) and (R'_3 and R'_4) form together with said C-atom, wherein they are attached to, an optionally substituted, saturated, partially saturated or aromatic,
20 mono- or polycyclic ring system as defined in claim 1, wherein said ring system is selected from phenyl, mono- or bicyclic cycloalkyl of 5-16 C-atoms or mono- or bicyclic heterocyclyl of 5-16 ring atoms with 1-4 N, O and/or S atoms; or each R_3 and R_4 and/or each R'_3 and R'_4 are independently H, alkyl, alkenyl, alkynyl, aryl, arylalkyl, cycloalkyl, cycloalkylalkyl, heterocyclyl or heterocyclylalkyl, wherein the cycloalkyl and heterocyclyl as a group or part of a group is
25 mono- or bicyclic ring with 5-16 ring atoms; and R_2 is H or a bond in said ring system between said C-atom and a ring atom adjacent thereto;

- or C-atom denotes together with H, R'_3 and R'_4 , which are attached thereto, a group $-R'_5([Z_1-Z_2-R_6-]_kZ_1-Z_2-R_5-H)_t$ as defined claim 1, wherein each R'_5 and R_5 is independently alkyl, cycloalkylene, cycloalkylenealkylene, arylene, arylenealkylene, heterocyclylene, heterocyclylenealkylene, cycloalkylenealkylenecycloalkylene, arylenealkylenearylene or heterocyclylenealkyleneheterocyclylene; each R_6 independently is alkylene, alkylene interrupted with one or more N, O and/or S, cycloalkylene, cycloalkylenealkylene, cycloalkylenealkylenecycloalkylene, arylene, arylenealkylene, arylenealkylenearylene,
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heterocyclylene, heterocyclylenealkylene or heterocyclylenealkyleneheterocyclylene, each -
 Z_1-Z_2 - are $-NR_1-NR_1-$, t is 1 or 2, and k is as defined in claim 1; whereby

each group or a moiety of a group defined as variants for R_3 , R_4 , R'_3 , R'_4 , R'_5 , R_5 and R_6
 optionally substituted independently with 1-3 of $-OH$, $-NH_2$, $-COOH$, alkyl, alkenyl, alkynyl,
 5 cycloalkyl, cycloalkylalkyl, aryl, arylalkyl, alkyl-C(O)-O-, alkenyl-C(O)-O- and/or alkyl-O-C(O)-,
 whereby cycloalkyl and/or aryl moiety as or in said substituents is optionally substituted with
 alkenyl;

as well as an oxide(s) at the azo moiety, a salt, an ester or an amide thereof.

11. A flame retardant composition according to claim 10, wherein the compound of formula
 (I) is a compound of formula (IIb')



15 wherein one or both of (R_3 and R_4) and (R'_3 and R'_4) form together with said C-atom, wherein
 they are attached to, a saturated, monocyclic ring system, wherein said ring system is
 selected from monocyclic cycloalkyl of 5-8 C-atoms; or each R'_3 and R'_4 are independently H,
 C_1-C_{20} alkyl or C_5-C_8 cycloalkyl; and R_2 is H or a bond in said ring system between said C-
 atom and a ring atom adjacent thereto.

12. A flame retardant composition according to claim 1, which comprises as component (b) a
 compound of formula (IIc)



wherein R_3 and R_4 form together with said C-atom, wherein they are attached to, a cycloalkyl
 of 5-8 C-atoms;

and C-atom denotes together with H, R'_3 and R'_4 , which are attached thereto, a group -

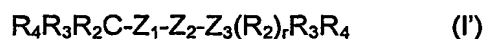
30 $R'_5([Z_1-Z_2-R_6-]_kZ_1-Z_2-R_5-H)_t$, wherein each R'_5 and R_5 is independently C_1-C_8 alkylene, C_5-
 C_8 cycloalkylene, C_5-C_8 cycloalkylene- C_1-C_8 alkylene, C_5-C_8 cycloalkylene- C_1-C_8 alkylene- C_5-
 C_8 cycloalkylene; each $-Z_1-Z_2-$ is $-N=N-$, t is 1 and k is 0.

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13. A flame retardant composition according to claim 1, that comprises
(c) a further flame retardant.

14. A flame retardant composition according to claim 13, wherein the further flame retardant is a halogenated flame retardant, a phosphorus compound, metal hydroxide, metal oxides, a melamine based flame retardant, N-hydrocarbyloxy substituted (NOR) hindered amine FR, an aluminium compound, an antimony compound or a boron compound or mixture thereof.

15. A flame retardant composition, which comprises
(a) a polymeric substrate, and
(b) a compound of formula (I')



wherein Z_1 and Z_2 are both NR_1 and Z_3 is C or N; r is 0, when Z_3 is N, and r is 1, when Z_3 is C;

the two R_1 's form together a bond or each R_1 is independently H or forms a bond together with R_2 present at the adjacent C-atom or, respectively, Z_3 ;

each R_2 independently forms a bond or is a monovalent radical as defined for R_3 and R_4 below;

each R_3 is independently and each R_4 is independently a monovalent radical selected from H, optionally substituted alkyl, optionally substituted alkyl interrupted with one or more O, N and/or S atom(s), optionally substituted cycloalkyl, optionally substituted cycloalkylalkyl, optionally substituted aryl, optionally substituted arylalkyl, optionally substituted alkoxy(alkyl)_n, optionally substituted aryloxy(alkyl)_n, optionally substituted arylalkyloxy(alkyl)_n, optionally substituted alkenyl, optionally substituted alkenyloxy(alkyl)_n, optionally substituted alkynyl, optionally substituted alkynyloxy(alkyl)_n, optionally substituted heterocyclyl(O)_s(alkyl)_n with one to four heteroatoms selected independently from N, O and S; $R-Y-C(O)-(alkyl)_n$ or $R-C(O)-Y-(alkyl)_n$, wherein each R independently is H, alkyl, alkenyl, cycloalkyl, aryl or

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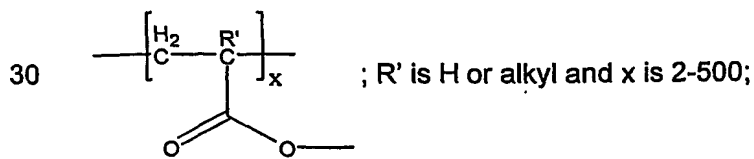
heterocyclyl as defined above, each of which is optionally substituted, Y is O or NH; each s and n is independently 0 or 1;

or at one or both of the C-atom and Z₃, as given in the above formula (I), R₃ and R₄ form together with said C-atom or, respectively, Z₃, wherein they are attached to, an optionally substituted, saturated, partially saturated or aromatic, mono- or polycyclic ring system of 5 to 20 carbon and, optionally, hetero ring atoms, whereby the optional hetero ring atoms are selected from N, O and/or S; and R₂ is a monovalent radical as defined for R₃ and R₄ above, or forms a bond between the C-atom and Z₁ or, respectively, between Z₃ and Z₂, or forms a bond in the ring system formed by R₃ and R₄ between said C-atom or, respectively, Z₃, and a ring atom adjacent thereto;

or Z₃ forms together with R₂, if present, R₃ and R₄, which are attached thereto, a group – R'₅([Z₁-Z₂-R₅]_kZ₁-Z₂-R₅-H)_t, wherein each R'₅ and R₅ is independently optionally substituted alkylene, optionally substituted alkylene interrupted with one or more N, O and/or S, optionally substituted cycloalkylene, optionally substituted cycloalkylenealkylene, optionally substituted cycloalkylenealkylenecycloalkylene, optionally substituted arylene, optionally substituted arylenealkylene, optionally substituted arylenealkylenearylene, optionally substituted heterocyclylene, optionally substituted heterocyclylenealkylene or optionally substituted heterocyclylenealkyleneheterocyclylene, each R₅ independently has a meaning as given for R'₅ and R₅ above, Z₁ and Z₂ are each independently as defined above, t is 1-3 and k is chosen so that the molecular weight of the resulting compound of formula (I) is within 200 to 10000 g/mol;

or Z₃ together with R₂, if present, R₃ and R₄, which are attached thereto, represent a linking group -R₈- to form R₂R₃R₄C-Z₁-Z₂-R₈-[U]_x which denotes a recurring structural unit of a polymer, wherein R₈ is a linking bond or alkylene, cycloalkylene, heterocyclylene or arylene;

U is a $\left[\text{CH}_2 - \underset{\text{O}}{\underset{\text{O}}{\text{C}}} \text{R}' \right]_x$, or



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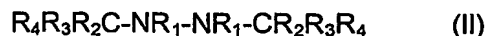
or the two R₃'s, as given in the above formula (I), form together with the -(R₂R₄)C-Z₁-Z₂-Z₃((R₂)_rR₄)- moiety an optionally substituted, saturated, partially saturated or aromatic, mono- or polycyclic ring system of 5 to 20 carbon and, optionally, further hetero ring atoms, whereby the further hetero ring atoms are selected from one or two of N, O and/or S; and wherein Z₁ to Z₃, r and R₂ to R₄ are as defined above;

as well as an oxide of N as Z₁-Z₃, a salt, an ester or an amide thereof, or a mixture of two or more compounds of formula (I') as defined above;

with the proviso that the composition does not contain any halogenated flame retardant compounds.

16. A flame retardant composition according to claim 15, wherein the compound of formula (I') is selected from the compounds of formulae (II)-(III):

a compound of formula (II)



wherein the two R₁'s form together a bond, or each R₁ independently is H or forms a bond together with R₂ present at the adjacent C-atom as defined above;

a compound of formula (III)



wherein the two R₁'s form together a bond; and

wherein in the above formulae (II)-(III) R₁ to R₄ are defined in claim 15.

17. A flame retardant composition according to claim 15, that comprises at least one further flame retardant (d) other than the compound of formula (I'),

with the proviso that the further flame retardant is other than a halogenated flame retardant compound.

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18. A composition of claim 17, which comprises a synergistic mixture of the compound of formula (I') and one or more further FR selected from a non-halogenated N-hydrocarbyloxy substituted (NOR) hindered amine flame retardant, aluminium compounds, boron compounds, magnesium hydroxide and/or intumescent systems.

19. A composition according to claim 1, 13, 15 or 17 comprising at least one further additive.

20. A composition according to claim 19, comprising as further additives phenolic and/or aminic antioxidants, hindered amine light stabilizers, UV-absorbers, phosphites, phosphonites, benzofuranones, metal stearates, metal oxides, pigments, dyes, organophosphorus compounds, hydroxylamines or flame retardants or mixtures thereof.

21. A method of flame retarding a polymeric substrate (a), wherein at least one compound of formula (I) as defined in claim 1 is added to the polymeric substrate.

22. A method of flame retarding a polymeric substrate (a), wherein at least one compound of formula (I') as defined in claim 15 is added to the polymeric substrate

with the proviso that the polymeric substrate does not contain one or more halogenated flame retardants.

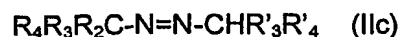
23. Use of a compound of formula (I) according to claim 1 as a flame retardant for a polymeric substrate (a).

24. Use of a compound of formula (I') according to claim 15 as a flame retardant for a polymeric substrate (a)

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with the proviso that the polymeric substrate does not contain one or more halogenated flame retardants.

5 25. A compound of formula (IIc)



wherein R_3 and R_4 form together with said C-atom, wherein they are attached to, an
 10 optionally substituted, saturated or partially saturated, mono- or polycyclic ring system as defined in claim 1; or each R_3 and R_4 are independently alkyl, alkenyl, alkynyl, aryl, arylalkyl, cycloalkyl, cycloalkylalkyl, heterocyclyl or heterocyclylalkyl, wherein the cycloalkyl and heterocyclyl as a group or part of a group is mono- or bicyclic ring with 5-16 ring atoms; or R_3 is H and R_4 is as defined above; and R_2 is H or a bond in said ring system between said C-
 15 atom and a ring atom adjacent thereto;

and C-atom denotes together with H, R'_3 and R'_4 , which are attached thereto, a group –
 $R'_5([Z_1-Z_2-R_6]_kZ_1-Z_2-R_5-H)_t$, wherein each R'_5 and R_5 is independently alkylene, alkylene interrupted with one or more O, N and/or S, cycloalkylene, cycloalkylenealkylene,
 20 cycloalkylenealkylenecycloalkylene, arylenealkylene, heterocyclylene, heterocyclylenealkyleneheterocyclylene or heterocyclylenealkylene; each R_6 independently is alkylene, alkylene interrupted with one or more N, O and/or S, cycloalkylene, cycloalkylenealkylene, cycloalkylenealkylenecycloalkylene, arylenealkylene, arylenealkylenearylene, heterocyclylene, heterocyclylenealkylene or
 25 heterocyclylenealkyleneheterocyclylene, each $-Z_1-Z_2-$ are $-NR_1-NR_1-$, t is 1 or 2, and k is as defined in claim 1; whereby
 each group or a moiety of a group defined as variants for R_3 , R_4 , R'_3 , R'_4 , R'_5 , R_5 and R_6 is optionally substituted independently with 1-3 of $-OH$, $-NH_2$, $-COOH$, alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkylalkyl, aryl, arylalkyl, alkyl-C(O)-O-, alkenyl-C(O)-O-, and/or
 30 alkyl-O-C(O)-, whereby cycloalkyl and/or aryl moiety as or in said substituents is optionally substituted with alkenyl;

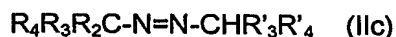
as well as an oxide(s) at the azo moiety, a salt, an ester or an amide thereof;

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with the proviso that in the compounds (IIc), (a) R_5 is other than methylene, and (b) when R'_5 is other than triazine, then the bridge formed by R_6 moiety between the two successive $-Z_1-Z_2-$ moieties separates said two $-Z_1-Z_2-$ moieties by 4 or more bridge atoms.

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26. A compound of formula (IIc) according to claim 25,



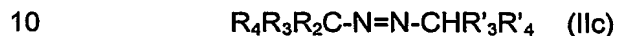
- 10 wherein R_3 and R_4 form together with said C-atom, wherein they are attached to, an optionally substituted, saturated or partially saturated, mono- or polycyclic ring system as defined in claim 1, wherein said ring system is selected from mono- or bicyclic cycloalkyl of 5-16 C-atoms or mono- or bicyclic heterocyclyl of 5-16 ring atoms with 1-4 N, O and/or S atoms; or each R_3 and R_4 are independently alkyl, alkenyl, alkynyl, aryl, arylalkyl, cycloalkyl, 15 cycloalkylalkyl, heterocyclyl or heterocyclylalkyl, wherein the cycloalkyl and heterocyclyl as a group or part of a group is mono- or bicyclic ring with 5-16 ring atoms; or R_3 is H and R_4 is as defined above; and R_2 is H or a bond in said ring system between said C-atom and a ring atom adjacent thereto;
- 20 and C-atom denotes together with H, R'_3 and R'_4 , which are attached thereto, a group $-R'_5([Z_1-Z_2-R_6]_kZ_1-Z_2-R_5-H)_t$, wherein each R'_5 and R_5 is independently alkylene, alkylene interrupted with one or more O, N and/or S, cycloalkylene, cycloalkylenealkylene, arylenealkylene, heterocyclylene or heterocyclylenealkylene; each R_6 independently is alkylene, alkylene interrupted with one or more N, O and/or S, cycloalkylene, 25 cycloalkylenealkylene, cycloalkylenealkylenecycloalkylene, arylenealkylene, arylenealkylenearylene, heterocyclylene, heterocyclylenealkylene or heterocyclylenealkyleneheterocyclylene, each $-Z_1-Z_2-$ are $-NR_1-NR_1-$, t is 1 or 2, and k is as defined in claim 1; whereby
- 30 each group or a moiety of a group defined as variants for R_3 , R_4 , R'_3 , R'_4 , R'_5 , R_5 and R_6 is optionally substituted independently with 1-3 of $-OH$, $-NH_2$, $-COOH$, alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkylalkyl, aryl, arylalkyl, alkyl-C(O)-O-, alkenyl-C(O)-O-, and/or alkyl-O-C(O)-, whereby cycloalkyl and/or aryl moiety as or in said substituents is optionally substituted with alkenyl;

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as well as an oxide(s) at the azo moiety, a salt, an ester or an amide thereof;

with the proviso that in the compounds (IIc), (a) R_5 is other than methylene, and (b) when R'_5 is other than triazine, then the bridge formed by R_6 moiety between the two successive $-Z_1-$
 5 Z_2- moieties separates said two $-Z_1-Z_2-$ moieties by 4 or more bridge atoms.

27. A compound of formula (IIc) according to claim 25



wherein R_3 and R_4 form together with said C-atom, wherein they are attached to, a cycloalkyl of 5-8 C-atoms;

and C-atom denotes together with H, R'_3 and R'_4 , which are attached thereto, a group –
 15 $R'_5([Z_1-Z_2-R_6]_kZ_1-Z_2-R_5-H)_t$, wherein each R'_5 and R_5 is independently C_1-C_8 alkylene, C_5-C_8 cycloalkylene, C_5-C_8 cycloalkylene- C_1-C_8 alkylene, C_5-C_8 cycloalkylene- C_1-C_8 alkylene- C_5-C_8 cycloalkylene; each $-Z_1-Z_2-$ is $-N=N-$, t is 1 and k is 0.

20 28. A compound of claim 25, which is 4,4'-bis(cyclohexylazo-cyclohexyl)methane.